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FLOOD INSURANCE STUDY

ORIGINAL



**CITY OF GRANBURY,
TEXAS**
HOOD COUNTY



JANUARY 15, 1988



Federal Emergency Management Agency

COMMUNITY NUMBER - 480357

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
CITY OF GRANBURY, HOOD COUNTY, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Granbury, Hood County, Texas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the U. S. Army Corps of Engineers (COE), Fort Worth District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, and all amendments thereto. This work was completed in June 1986.

1.3 Coordination

On March 23, 1983, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of the City of Granbury, FEMA, and the COE (the study contractor). Flooding sources that would be studied were established, and local floodplain regulations, available mapping, flood history, and other hydrologic data were discussed. In addition, problem locations in the study area were noted by city officials.

Available data were requested from the following sources: the U. S. Geological Survey (USGS); the U. S. Coast and Geodetic Survey (USC & GS); Greenhorne and O'Mara, Inc.; the Soil Conservation Service (SCS); Dewberry and Davis; the Texas Water Commission; the Texas Department of Public Transportation; and the Brazos River Authority.

On February 24, 1987, a final CCO meeting was held with representatives of the city, FEMA, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Granbury, Hood County, Texas. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: the Brazos River, from approximately 8,600 feet downstream of the southern corporate limits to approximately 800 feet upstream of State Route 426 including Lake Granbury; Rough Creek, for its entire length within the community; Lambert Branch, from its confluence with the Brazos River to the upstream corporate limits, located south of U. S. Route 377; Stream LB-1, from its confluence with Lambert Branch to the upstream corporate limits; and Stream LB-2, from its confluence with Lambert Branch to approximately 500 feet upstream of U. S. Route 377. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through June 1991.

2.2 Community Description

The City of Granbury, the county seat of Hood County, is located approximately 45 miles southwest of the City of Fort Worth on the Brazos River and the Gulf Coast and Santa Fe Railroad. It is completely surrounded by the unincorporated areas of Hood County.

Hood County is regarded as hilly and has sandy and sandy loam soils. The Brazos and Paluxy Rivers flow through the county. Recreation and recreational facilities include fishing, summer theater, scenic areas, Lake Granbury, and Acton State Park. Other communities near Granbury are the Village of Lipan, population 435; the Town of Tolar, population 415; the Town of Cresson, population 208; and the Town of Acton, population 130 (Reference 1).

Granbury is located in a region of temperate mean climatological conditions, experiencing occasional extremes of temperature and rainfall of relatively short duration. The National Oceanic and Atmospheric Administration (NOAA) station at the City of Fort Worth shows an average rainfall of 32.30 inches for the past 10 year period. The extremes in rainfall during the past 57 years are a maximum of 51.03 inches occurring in 1932 and a minimum of 17.91 inches occurring in 1921. The mean relative humidity is 65 percent and the average temperature is 65.8 degrees (Reference 2).

Granbury was settled in 1854 by Thomas Lambert, who along with J. F. Nutt and J. Nutt donated the forty acres of land to form the site of the city. After a contest over the location of the county seat, the scanty official records and the mercantile firm of Kingsburg and Holmsley moved from Stockton to the new town. A sawmill supplied the incoming population with building materials, and business houses that were built in 1871 include the Granbury House and the Beef Market. A. P. Harbin taught the first public school and the first church was organized by the Methodists, also in 1871. In 1872, the Vidette, the first newspaper, was established by W. L. Bond. Later it was bought by Ashley Crockett, who changed its name to the Graphic. In 1886, the Granbury News was established by Jeff D. Ballard.

Granbury College, essentially a district high school, was established in 1873 under the direction of the Methodist Episcopal Church, South. By 1883 the school had a three story building and enrolled 313 pupils. Because of improved conditions in public education and competition with other denominational schools, the college was suspended and its property sold. Weatherford College is regarded as a continuation of that school (Reference 3).

In 1940, Granbury had 48 businesses and a population of 1,166. By 1950, 65 business were in operation and the population had increased to 1,679 (Reference 3). Granbury had a population of 2,227 in 1960, 2,473 in 1970, and 3,332 in 1980 (References 4 and 5). In 1970, there were 65 industries concerned with the manufacture of toys and clothing and the processing of feeds, peanuts, and pecans (Reference 4). By 1982, the population had increased to 3,300 (Reference 1).

2.3 Principal Flood Problems

Generally, the major storms experienced in the vicinity are produced by heavy rainfall from frontal-type storms that may occur at any time during the year but are more prevalent in the spring and summer months. Major flooding can be produced by the intense rainfall usually associated with these localized thunderstorms.

There are two USGS stream gaging stations on the Brazos River near Lake Granbury; one is near the City of Dennis and the other near the City of Glen Rose.

The gaging station near Dennis is at river mile 389.8, upstream of Lake Granbury, and has a record from May 1968 to the present. Flow at this gage is largely regulated by upstream releases from storage in Possum Kingdom Lake, completed in 1941, and Lake Palo Pinto, completed in 1964. The gage height of 729.52 feet reached during the flood of October 14, 1981, was the highest since at least 1930. A floodwater mark of 729.47 feet NGVD was observed in May 1957.

The gaging station near Glen Rose is at river mile 511.2, downstream of Lake Granbury, having a record from September 1969 to the

present. Flow at this gage has been regulated by Lake Granbury since September 1969 and by the same structures affecting the Dennis gage prior to 1969.

2.4 Flood Protection Measures

Lake Granbury is formed by the De Cordova Bend Dam located at river mile 542.5 of the Brazos River, 7.5 miles southeast of the City of Granbury. The 2,256 feet long Ambursen type concrete and earth fill dam was built by the Brazos River Authority for the conservation of water for irrigational, municipal, and industrial uses. The dam includes a 932-foot concrete spillway consisting of 16 tainter gates that are 36 feet by 35 feet and two sluice gates that are 7 feet by 8 feet. The lake has a drainage area of 256,679 square miles, of which 9,566 square miles are probably noncontributing. Deliberate impoundment of Lake Granbury began on September 15, 1969.

Since Lake Granbury has no storage space specifically provided for flood control purposes, flood flows will be passed through the lake essentially as they occur. The presence of De Cordova Bend Dam has the effect of raising the elevation of flooding in the Brazos River valley around the lake shore to a level higher than would occur without the dam in place. To minimize this effect, the water surface of Lake Granbury will be drawn down during flood operations in advance of anticipated flood flows. For larger Brazos River system floods coming through Possum Kingdom Dam, there is considerable warning time since the travel time of flood releases from Possum Kingdom is approximately 48 hours. Due to the significant gate capacity at Lake Granbury, the system floods can generally be held to 694.1 feet at the De Cordova Bend Dam; however, local floods that are generated off the surface of Lake Granbury and nearby watersheds are not always predictable and watershed response is prompt.

There is a levee near the confluence of the Brazos River and Lambert Branch. FEMA specifies that all levees must have a minimum of 3 foot freeboard against 100-year flooding to be considered a safe flood protection structure. This levee meets FEMA freeboard requirements.

No other major structural flood protection measures exist or are currently planned for the City of Granbury. Non-structural floodplain management is regulated by ordinance.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been

selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Flow frequencies for all streams except the Brazos River were developed using the computer program NUDALLAS (Reference 6). The watershed was divided into sub-basins, and synthetic unit and flood hydrographs were developed at selected locations. Weather Bureau Technical Paper No. 40, NOAA Technical Memorandum NWS Hydro-35, and the COE Civil Engineer Bulletin No. 52-8 were used in developing the 10-, 50-, and 100-year frequency storms (References 7, 8, and 9). The 500-year storm was based on extrapolated data. Peak discharge-frequency values were computed for selected locations. Routing of the flood hydrographs through each sub-basin reach was accomplished using a modified Puls reservoir routing. The HEC-2 backwater model provided the elevation-discharge-storage relationships for each stream studied by detailed methods (Reference 10).

The 10-, 50-, and 100-year flood hydrographs for the Brazos River were developed from a volume-duration-frequency analysis using the October 1981 flood at the Dennis gage as a pattern hydrograph and information from the USGS stream gaging stations on the Brazos River near Dennis and Glen Rose with a period of record from 1941 to 1983. Floods from the main stem of the Brazos River are critical for backwater through the long, narrow surface area of Lake Granbury. The 10-, 50-, and 100-year floods were routed through Lake Granbury using the computer program WATERS (Reference 11). The WATERS program uses the modified Puls routing technique similar to the HEC-1 computer program. The model was started at elevation 689.1 feet, with storage obtained from HEC-2 water-surface profile calculations. Under the Brazos River Authority plan of regulation, the 689.1 feet starting water-surface elevation is reasonable for a predictable system flood. Since there was no sediment resurvey data

available, the flat pool storages were based on initial storage conditions at the time of construction of De Cordova Bend Dam. The 500-year flood for the Brazos River was assumed to be the standard Project Flood routed through Lake Granbury developed in the Brazos River Basin Spillway Design Flood Study (Reference 12).

For larger Brazos River system floods coming through Possum Kingdom, there is considerable warning time, as the travel time of flood releases from Possum Kingdom is approximately 48 hours. Due to the significant gate capacity at Lake Granbury, the system floods can generally be held to 694.1 feet NGVD at the De Cordova Bend Dam; however, local floods that are generated off the surface of Lake Granbury and nearby watersheds are not always predictable and watershed response is prompt.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
BRAZOS RIVER					
At De Cordova Bend Dam	25,679	53,100*	96,300*	123,700*	221,700*
At State Route 426	25,460	56,900	106,200	134,900	221,700
ROUGH CREEK					
At State Route 144	7.06	7,390	10,100	11,380	13,200
Adjacent to Fiesta Way	6.48	7,020	9,590	10,900	12,650
At Live Oak Trail	6.15	7,000	9,620	10,840	12,490
LAMBERT BRANCH					
At State Route 426	5.52	4,450	6,230	7,120	8,450
At Houston Street	5.02	4,240	5,950	6,810	8,100
Just downstream of confluence of Stream LB-1	4.67	4,620	6,440	7,290	8,560
Just upstream of confluence of Stream LB-1	2.55	2,490	3,420	3,850	4,560
Just downstream of confluence of Stream LB-2	2.23	2,380	3,260	3,660	4,330
Just upstream of confluence of Stream LB-2	1.49	1,850	2,540	2,860	3,310*

* Decreased due to storage routing effects

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
STREAM LB-1					
At confluence with Lambert Branch	2.12	2,200	3,100	3,550	4,100
STREAM LB-2					
At confluence with Lambert Branch	0.74	550	730	820	1,050
At U. S. Route 377 Bypass	0.54	350	460	550	870

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis were obtained from bridge data obtained by field measurements and by bridge plans from the Texas Department of Highways and Public Transportation and from the City of Granbury.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2). Along certain portions of the Brazos River and Lambert Branch, a profile base line is shown on the maps to represent channel distances as indicated on the flood profiles and floodway data tables.

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 10). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the Brazos River, Rough Creek, and Lambert Branch were taken from the conservation pool elevation on Lake Granbury. The elevations for Stream LB-1 and Stream LB-2 were based on slope/area computations.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observation of the streams and floodplain areas. The following tabulation lists channel and overbank "n" values for the streams studied by detailed methods:

<u>Stream</u>	<u>Channel "n"</u>	<u>Overbank "n"</u>
Brazos River	0.030	0.080
Rough Creek	0.035 - 0.065	0.060 - 0.085
Lambert Branch	0.035 - 0.065	0.065 - 0.090
Stream LB-1	0.050	0.070
Stream LB-2	0.020 - 0.060	0.060 - 0.080

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 13).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. A floodway was not computed for the Brazos River due to the storage capacity of the lake area. A Floodway Data Table was not prepared for Rough Creek, since there are no cross sections within the community.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 2 for certain downstream cross sections of Stream LB-1 are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Lambert Branch								
A	5,920 ¹	160	1,030	6.8	699.4	699.4	699.4	0.0
B	6,750 ¹	150	1,232	5.5	702.6	702.6	702.8	0.2
C	7,180 ¹	77	667	10.2	702.8	702.8	703.0	0.2
D	8,070 ¹	140	1,106	6.2	705.9	705.9	706.0	0.1
E	8,550 ¹	240	1,968	3.5	710.5	710.5	711.2	0.7
F	9,600 ¹	200	1,235	5.5	714.6	714.6	715.3	0.7
G	10,500 ¹	280	2,317	3.1	717.6	717.6	718.4	0.8
H	12,200 ¹	310	1,866	3.9	719.7	719.7	720.5	0.8
I	13,830 ¹	200	1,178	3.3	723.4	723.4	724.0	0.6
J	14,470 ¹	130	590	6.5	724.6	724.6	725.2	0.6
K	15,930 ¹	130	929	3.9	732.1	732.1	732.9	0.8
L	17,450 ¹	150	523	5.5	741.3	741.3	741.7	0.4
M	18,520 ¹	180	623	4.6	751.5	751.5	752.4	0.9
N	19,950 ¹	241	1,217	2.4	764.3	764.3	765.3	1.0
O	20,660 ¹	180	585	4.9	768.2	768.2	768.7	0.5
P	21,540 ¹	169	762	3.8	775.1	775.1	776.0	0.9
Stream LB-1								
A	820 ²	144	783	4.5	720.8	720.4 ³	721.0	0.6
Stream LB-2								
A	1,140 ²	160	700	1.2	742.1	742.1	743.1	1.0
B	2,990 ²	80	187	2.9	755.7	755.7	756.6	0.9

¹Feet above confluence with Brazos River

²Feet above confluence with Lambert Branch

³Elevation computed without consideration of backwater effects from Lambert Branch

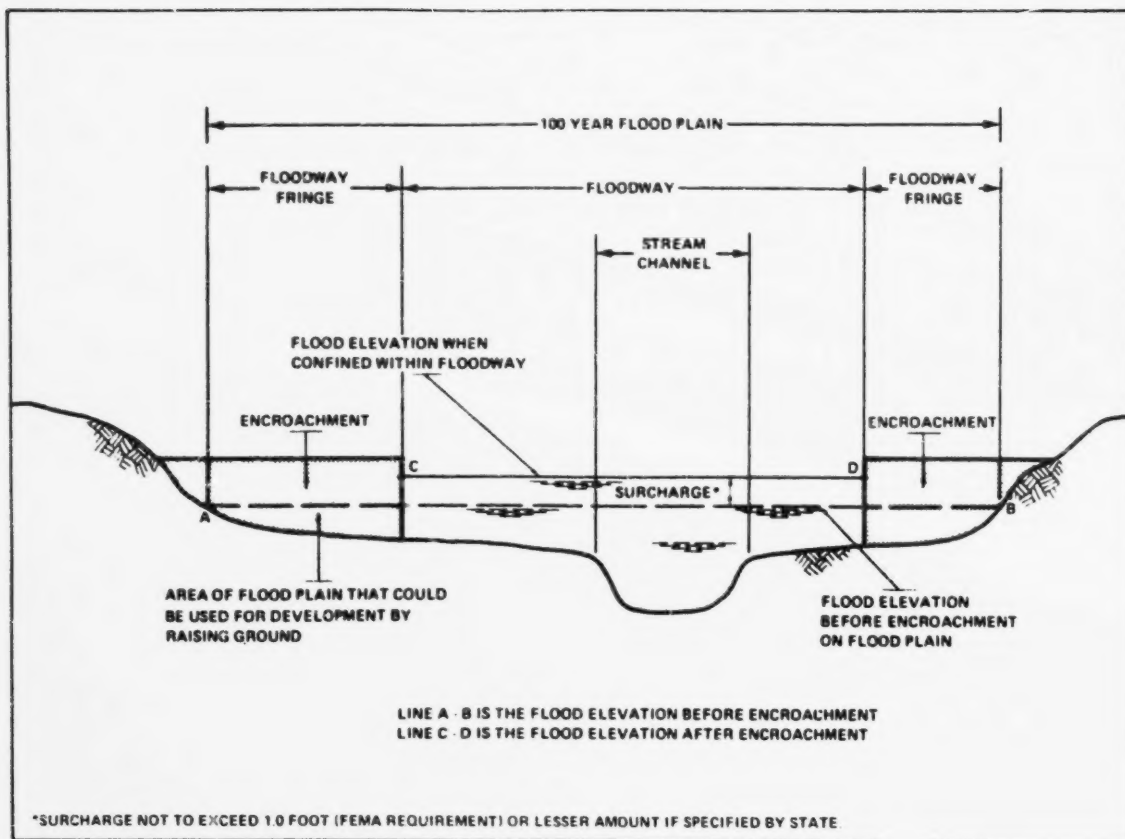
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRANBURY, TX
(HOOD CO.)

FLOODWAY DATA

LAMBERT BRANCH - STREAM LB-1 - STREAM LB-2



FLOODWAY SCHEMATIC

Figure 2

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone A0

Zone A0 is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

There are no studies known to exist concerning flood problems in the City of Granbury.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Federal Regional Center, 800 North Loop 288, Denton, Texas 76201.

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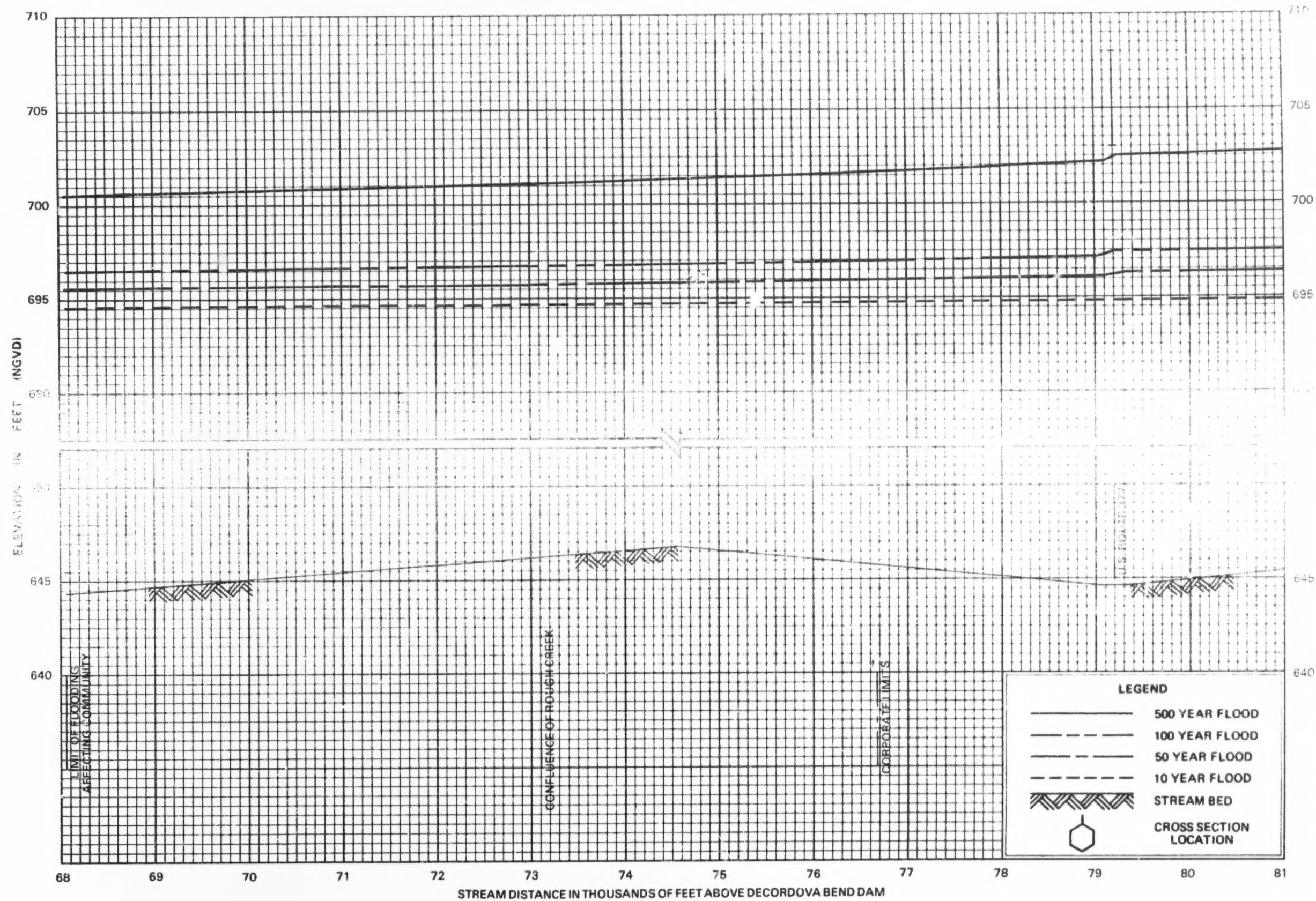
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13. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Acton, Texas, 1961, Photorevised 1979; Granbury, Texas, 1961, Photorevised 1979.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

<u>Reference Mark</u>	<u>FIRM Panel</u>	<u>Elevation (Feet NGVD)</u>	<u>Description of Location</u>
RM 1	05	725.68	60d nail in power pole, 110 feet west of railroad bridge and 39 feet north of Gulf Coast & Santa Fe Railroad track. Bridge is located approximately 2,500 feet west of Travis Street crossing.
RM 2	05	704.77	Chiseled square cut in northwest corner of northwest abutment on Crockett Street over Lambert Branch approximately 240 feet south of Rucker Street.
RM 3	05	706.44	Chiseled square cut in west end of north concrete guardrail on U. S. Route 377 over Lambert Branch, approximately 60 feet east of gravel road leading to sewage treatment plant.
RM 4	05	739.36	Chiseled square cut in northwest corner of north headwall of box culvert on U. S. Route 377 over Stream LB-2 approximately 215 feet east of intersection of Park Road.
RM 5	05	746.83	Chiseled square cut in northwest corner of west headwall on Ables Street over Stream LB-2.
RM 6	05	734.89	Chiseled square in northeast corner of intersection of Morgan Street and U. S. Route 377 on northwest corner of concrete pad for traffic signal.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

<u>Reference Mark</u>	<u>FIRM Panel</u>	<u>Elevation (Feet NGVD)</u>	<u>Description of Location</u>
RM 7	05	738.09	Chiseled square 14 feet west and 134 feet south of intersection with Spanish Trail Drive and Sierra Vista Drive.
RM 8	05	722.28	Chiseled square in centerline of stone pillars, 27 feet south of centerline of Spanish Trail Drive and 45 feet west of centerline of State Route 144.



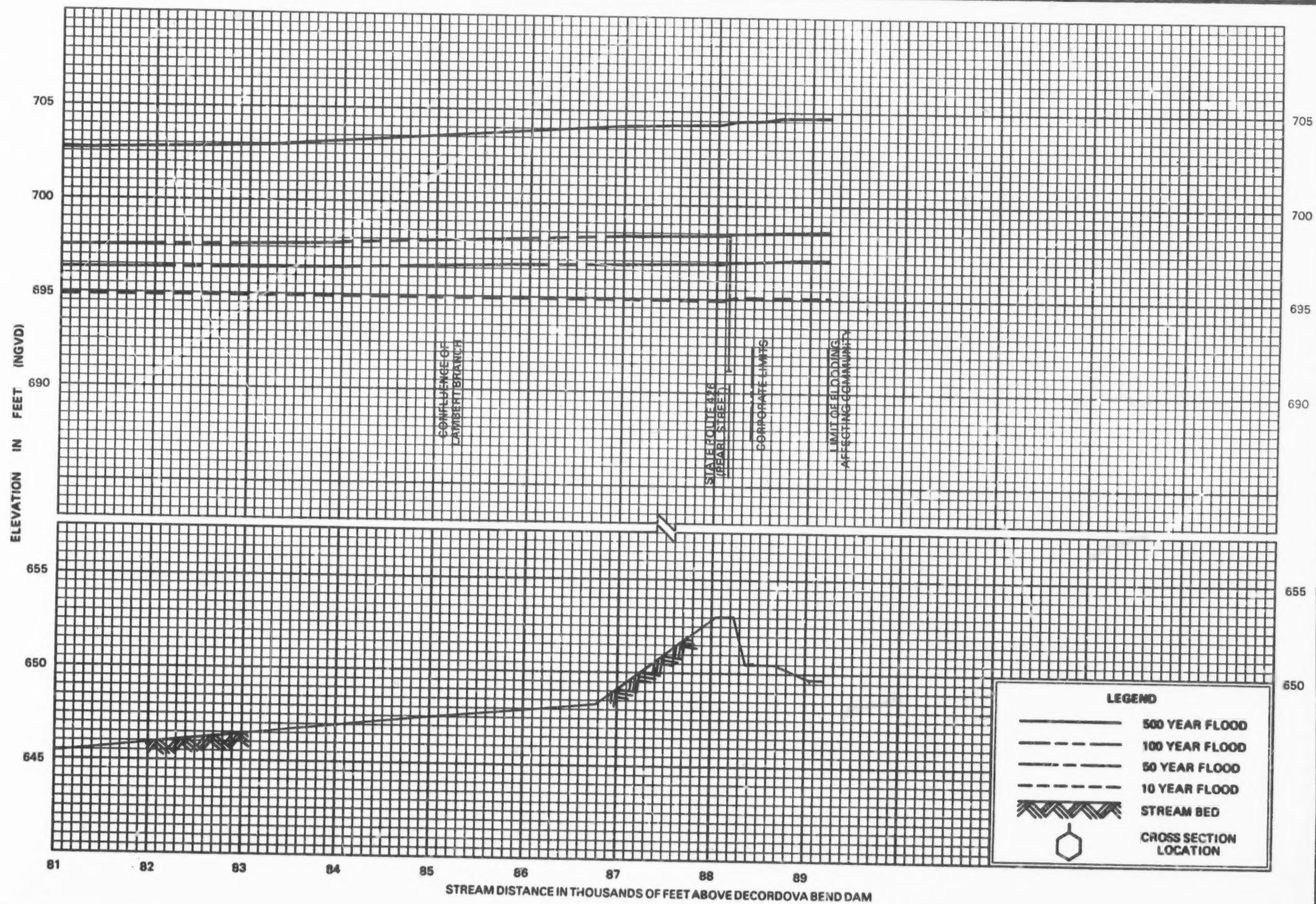
FLOOD PROFILES

BRAZOS RIVER

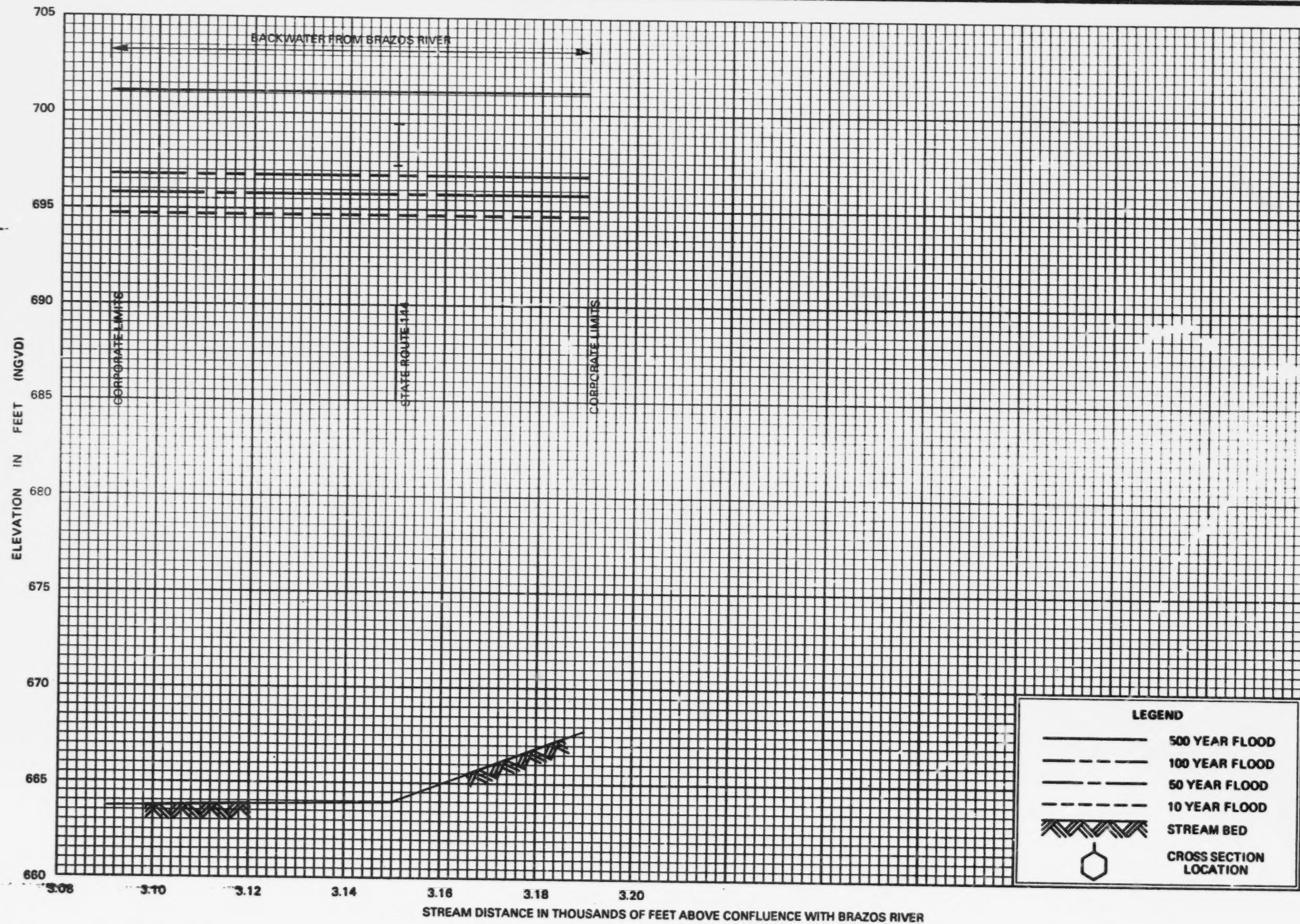
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CITY OF GRANBURY, TX

(HOOD CO.)



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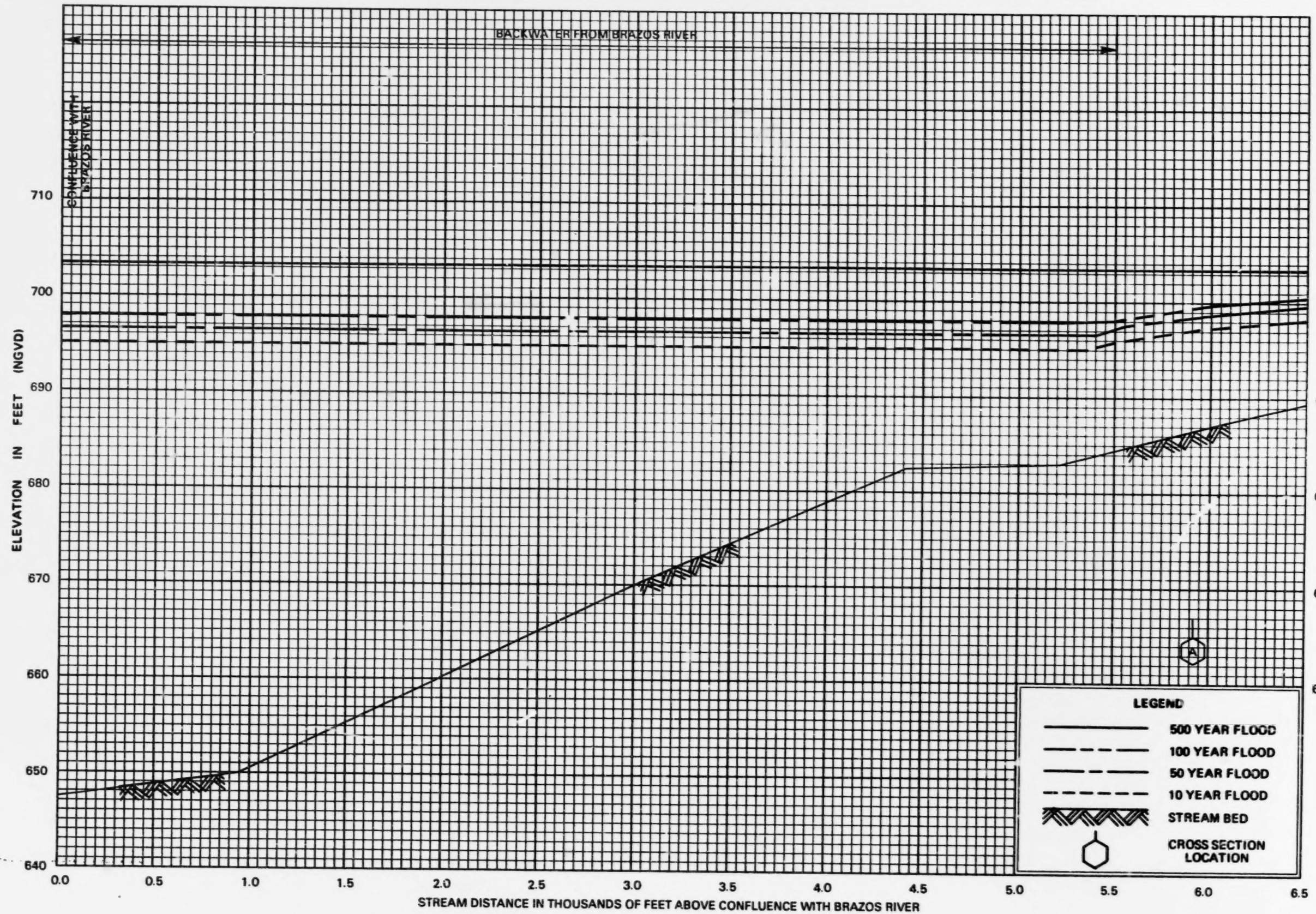
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FLOOD PROFILES

ROUGH CREEK

CITY OF GRANBURY, TX
(HJOD CO.)

03P



FLOOD PROFILES

LAMBERT BRANCH

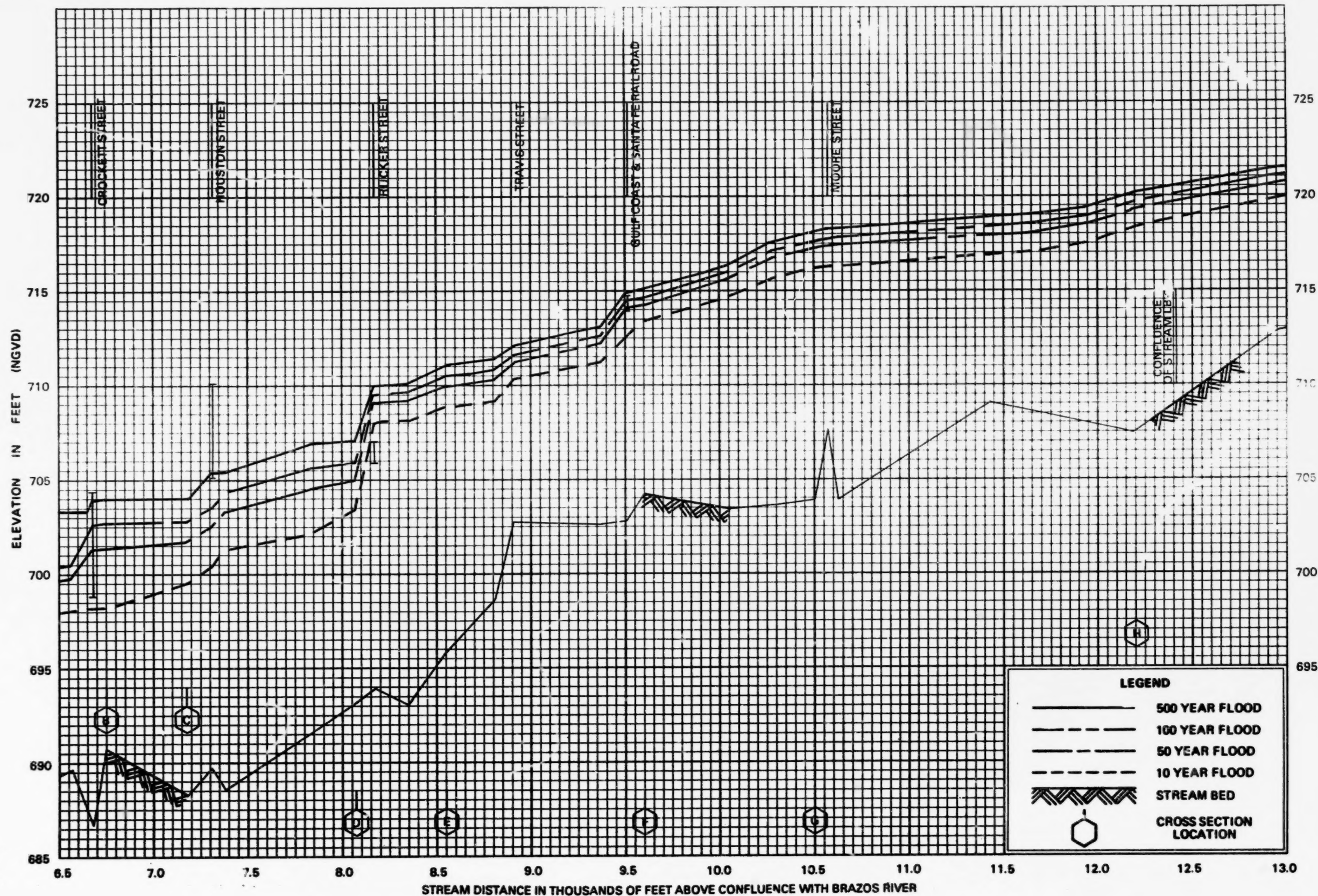
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(HOOD CO.)

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FLOOD PROFILES

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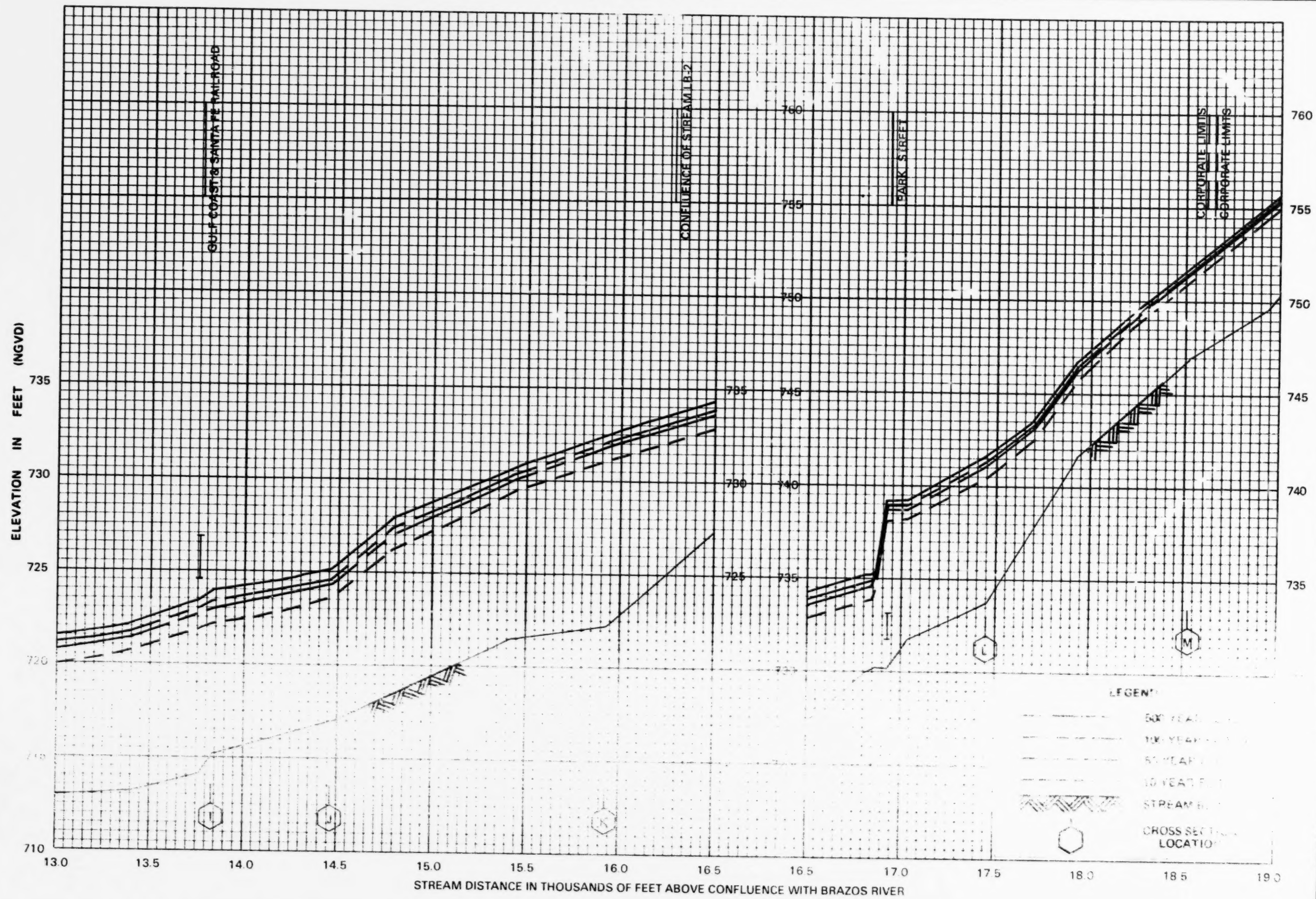
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CITY OF GRANBURY, TX
(HOOD CO.)

05P

22

134488



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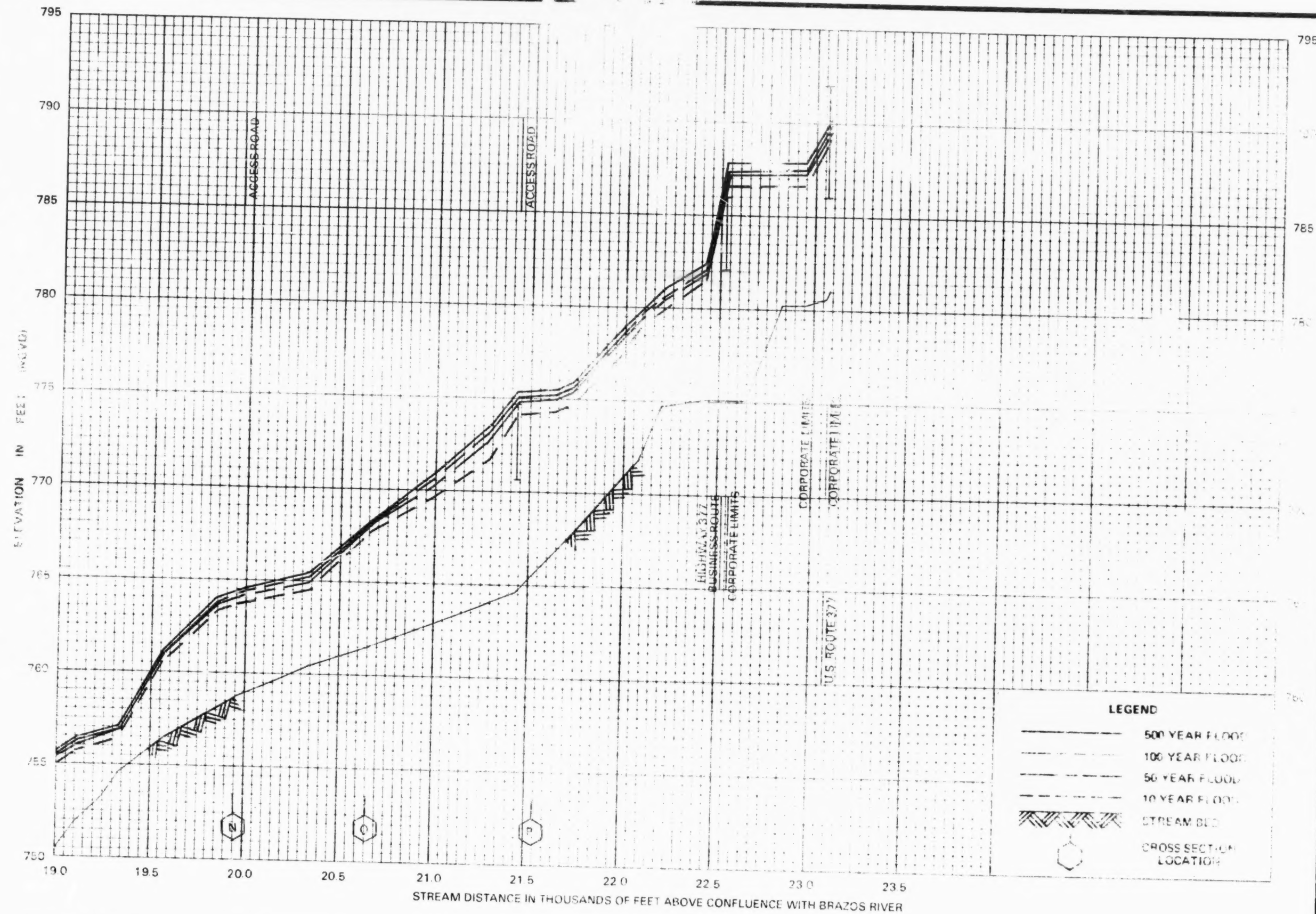
LAMBERT BRANCH

ENGINEERING AGENCY

HOUSTON, TEXAS

06P

124488



FLOOD PROFILES
AMBERT BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

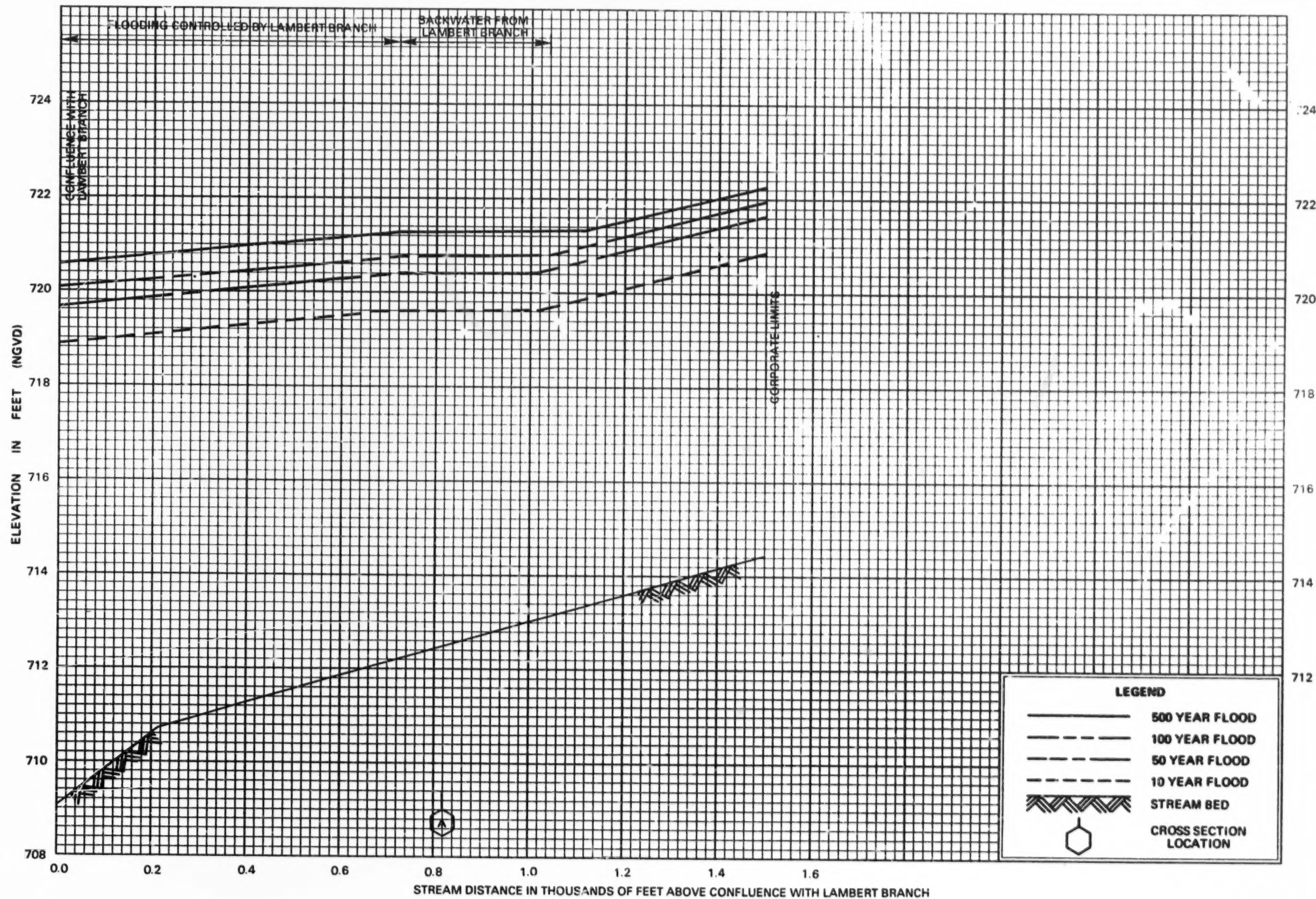
CITY OF GRANBURY, TX

(FLOOD CO 1)

07P

24

154-005



FLOOD PROFILES

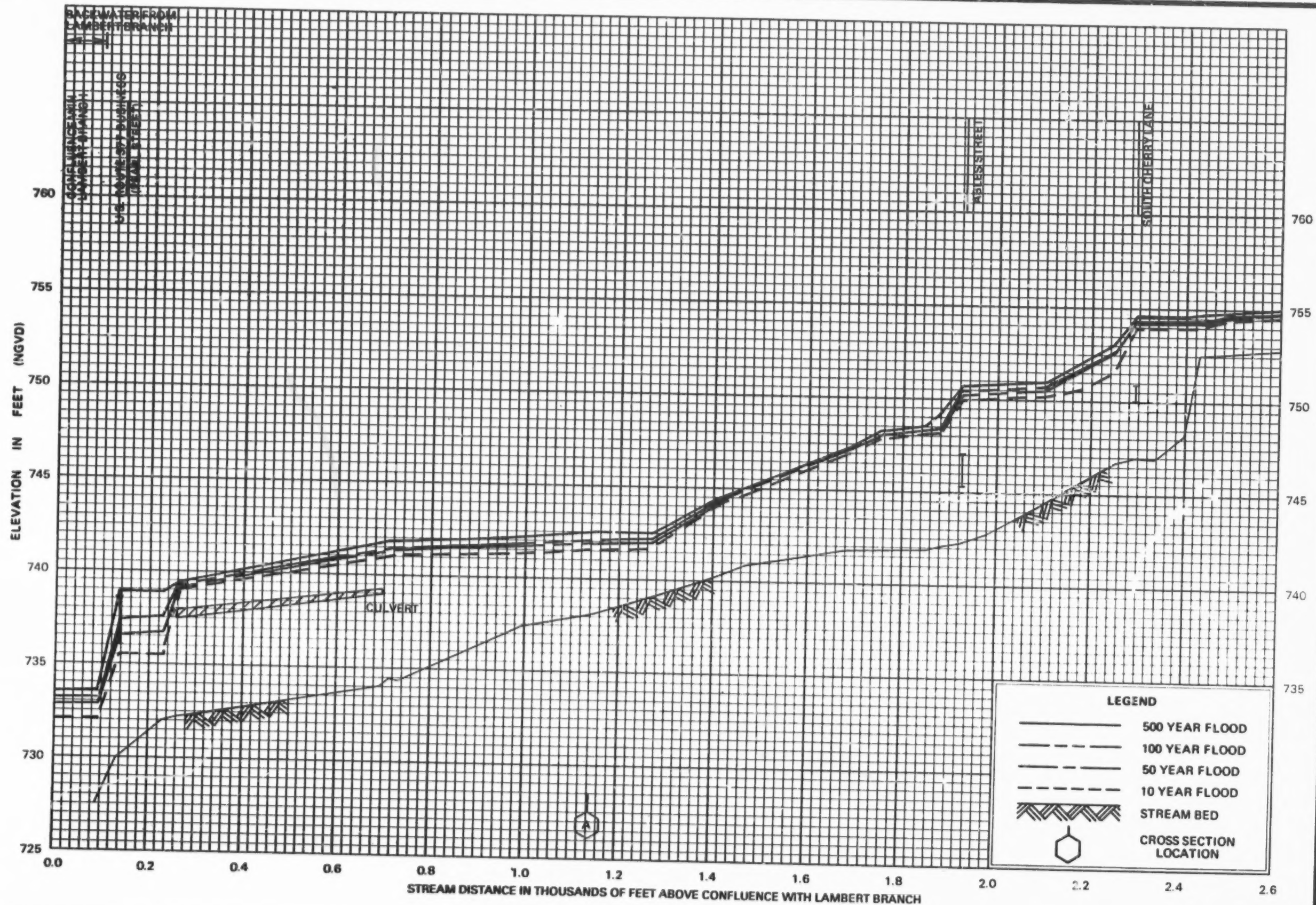
STREAM LB-1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRANBURY, TX

(HOOD CO.)

08P



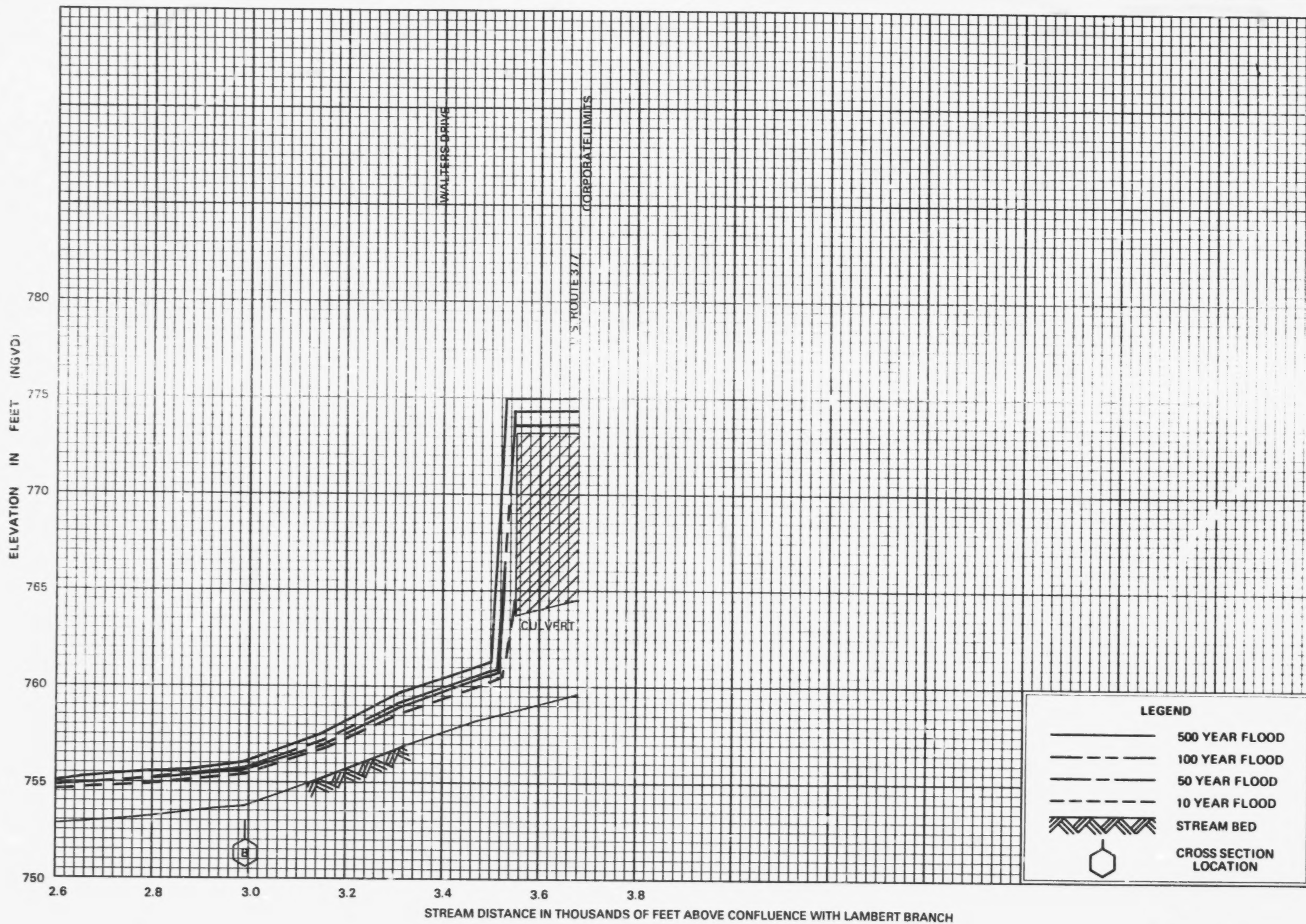
FLOOD PROFILES

STREAM LB-2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CRANBURY, TX
(HOOD CO.)

09P



FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD PROFILES

CITY OF GRANBURY, TX
(HOOD CO.)

STREAM LB-2